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CROSSBREEDING OF IRANIAN FAT-TAILED SHEEP – V. THE PHENOTYPIC RELATIONSHIPS BETWEEN SOME GROWTH TRAITS AND WOOL PRODUCTION[1]

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Abstract – The phenotypic associations between some growth traits and wool production at 6 months (308 samples) were studied in three fat-tailed Iranian breeds of sheep, Karakul, Mehraban and Naeini, and all their reciprocal crosses. The relationship between wool production at 6 months of age and the subsequent wool production at 15 months of age was also estimated.

Birth weight, weaning weight and daily gain from birth to weaning showed positive and mostly significant associations with the body weight of females from 7 to 16 months of age. The pre-weaning daily gain showed the highest association whereas birth weight had the lowest association. There were positive associations between the pre-weaning traits with wool production at 6 and 15 months of age, with birth weight showing the highest association. The association, at 6 months of age, between wool production and body weight at shearing was positive and highly significant, whereas the same relationship became negligible at 15 months of age. Wool production at 6 months of age had significant positive association with the subsequent wool production at 15 months of age, pointing out the prediction value of wool production at 6 months of age for early selection.

INTRODUCTION

Generally, most of the native breeds of sheep in Iran are multi-purpose breeds, being raised for meat, wool and milk production. No classical selection program has been practiced on these breeds.

Estimation of the degree of association between the above mentioned traits is necessary for formulating breeding plans for breed improvement purposes.

Turner [17] reviewed the literature on the genetic relationships between meat, wool and milk production in sheep and concluded that there were no major negative associations between desirable characteristics. However, these relationships have not been studied in the fat-tailed native breeds of sheep in Iran.

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The purpose of this investigation was to estimate the phenotypic relationships among some growth and wool production traits during the first 15 months of age in 3 fat-tailed Iranian breeds of sheep (Karakul, Mehraban and Naeini) and their reciprocal crosses.

MATERIALS AND METHODS

Data collected on growth performance and greasy wool production of sheep during the first 15 months of life were used in this study. The animals were of 3 straightbred Iranian fat-tailed breeds (Karakul, Mehraban and Naeini) and all their reciprocal crosses. The source of data, pre-weaning growth, feedlot performance and wool production studies of these animals have been reported in the previous publications [5, 9].

Briefly, the lambs were born single from December 1972 to February 1973. The lambs were creep-fed and weaned at 75 ± 10 days of age. After weaning, the ram lambs were fattened individually for 120 days. The crossbred ewe lambs were group-fed the same ration as the ram lambs for the same period. Straightbred ewe lambs were managed as replacements and the crossbred ewe lambs were run with the straightbreds in a single flock after the feedlot.

The ram lambs and crossbred ewe lambs were shorn while they were in feedlot at approximately 6 months of age. The straightbred ewe lambs were also shorn at the same age. The straightbred and crossbred females were shorn again when they were approximately 15 months old.

The least-squares method of fitting constants was used to calculate the adjusted regression coefficients [6]. In order to estimate the adjusted regression coefficient of wool production at 6 months of age on the other traits, constants were fitted for breeding groups (3 straightbred and 6 crossbred groups), age of dam, sex of lamb, the regression of wool production on age at shearing and the regression of wool production on the traits. For the wool production at 15 months of age, constants were fitted for breed groups and age of dam. Similar models were used for estimating the coefficients of regression of body weights at different ages on the pre-weaning traits. In each case, different traits as well as age at shearing were considered as covariables in the models. Gross correlation coefficients were also calculated without making any adjustment on the data.

RESULTS AND DISCUSSION

Relationship between pre-weaning traits and body weight of females at different ages

The estimated gross correlation between the pre-weaning traits and body weight of females at different ages are presented in Table 1. Birth weight, pre-weaning average daily gain and weaning weight had positive correlations with the subsequent body weight ($p < 0.01$). However, the correlation coefficients decreased with the increase in the age of animals, and birth weight was not significantly correlated with subsequent body weight by the time the animals were 16-months old.

The estimate of the correlation between birth weight and body weight at 13 months of age is in close agreement with the estimates between birth and yearling weight reported by Fahmy *et al.* [4] and Ursescu *et al.* [19]. Shelton's [14] estimate of 0.48 for the correlation between birth and yearling weights is much higher than the estimate in

Table 1.

The estimate of the correlation between body weights at weaning and at 13 months in Table 1 is much higher than the values of 0.38 and 0.37 reported by Ursescu *et al.* [19] and Fahmy *et al.* [4], respectively, but very similar to the estimate reported by Shelton [14]. Young *et al.* [21] reported a lower value (0.35) for the correlation between weights at weaning and at 15–16 months.

The estimated correlations between pre-weaning rate of gain and yearling weight of 0.63 and 0.45 reported by Shelton [14] and Fahmy *et al.* [4], respectively, were somewhat lower than the corresponding figure in Table 1.

The adjusted regression coefficients of body weights at different ages on the pre-weaning traits were also positive and significant, except for the regression of body weight at 16 months of age on birth weight which was not significant (Table 1). The contribution of birth weight to total variation in body weight at different ages was relatively small and decreased as age increased. The contributions of weaning weight and pre-weaning average daily gain to variation in body weights at later ages were approximately similar and much higher than that of birth weight. Positive regressions of yearling weight on both birth and weaning weights were also reported by Ursescu *et al.* [19].

Relationships between wool production and the pre-weaning traits

Birth weight. The gross correlations between wool production at different periods and birth weight are shown in Table 2. The gross correlation coefficients between greasy fleece weight at 6 months, 6–15 months and birth to 15 months and birth weight were all positive and highly significant ($p < 0.01$).

The estimated correlation coefficient between birth weight and wool production from birth to 15 months of age was somewhat higher than the corresponding estimates reported by Vesely *et al.* [20] in Rambouillet and Romnelet breeds (0.24 and 0.25, respectively) shorn at 395 days of age. Lower estimates were also reported by Ursescu *et al.* [19] in Merino (0.20) and by Fahmy *et al.* [4] in Egyptian Barki sheep (–0.03).

The correlation between wool production from birth to 6 months and birth weight was higher than the correlation between birth weight and wool production from 6 to 15 months, indicating that the effect of birth weight on wool production decreased as age increased.

The adjusted regression coefficients of wool production at different stages on birth weight are shown in Table 2. Regression coefficients became non-significant for wool obtained at 15 months. The contribution of birth weight to total variation of wool production at all ages was small.

Weaning weight and pre-weaning average daily gain. The correlation coefficient between weaning weight and wool production at 6 months of age, and also the correlation between pre-weaning average daily gain and wool production at 6 months of age, were both positive and highly significant (Table 2). The results are in agreement with the estimates reported by Young *et al.* [21] but they somewhat differ with the findings of Botkin *et al.* [1] who reported a negative correlation between fleece growth and body growth.

The correlations between weaning weight and wool production after 6 months (between 6 and 15 months and between birth and 15 months) and also the correlations between pre-weaning average daily gain with wool production after 6 months of age, were

Table 1. Relationships between body weight of female group (kg) at different ages with pre-weaning traits*

Independent variable	Body wt at 7 months			10 months			13 months			16 months		
	r	*b*	%*v*	*r*	*b*	%*v*	*r*	*b*	%*v*	*r*	*b*	%*v*
Birth weight, kg	0.28‡	2.19‡	3.5	0.25‡	1.80‡	2.7	0.21‡	1.71†	1.9	0.13	1.25	0.8
Weaning weight, kg	0.70‡	0.87‡	23.6	0.69‡	0.77‡	21.2	0.66‡	0.83†	18.1	0.55‡	0.76‡	10.5
Pre-weaning daily gain, g	0.72‡	0.08‡	23.0	0.72‡	0.07‡	22.6	0.68‡	0.07†	17.5	0.58‡	0.07‡	10.8

*Number of observations = 134; *r* = gross correlation coefficient; *b* = adjusted regression coefficient; %*v* = per cent of variation accounted for by the regression.

†Significant at $p<0.05$.

‡Significant at $p<0.01$.

Table 2. Relationships between wool production (g) at different periods with some pre- and post-weaning traits*

Independent variable	Wool production from Birth to 6 months§			6 to 15 months¶			Birth to 15 months¶		
	r	*b*	%*v*	*r*	*b*	%*v*	*r*	*b*	%*v*
Birth weight, kg	0.45‡	77.6‡	1.1	0.27‡	43.8	0.5	0.36‡	168.2†	2.4
Weaning weight, kg	0.36‡	22.8‡	3.0	0.03	2.7	0.1	0.09	17.0	0.7
Pre-weaning daily gain, g	0.27‡	1.7‡	2.5	0.07	0.8	0.7	0.08	1.6	0.7
Body weight at shearing, kg	0.35‡	14.7‡	3.9	–0.05	3.8	0.4	–0.07	8.1	0.6
Daily gain from birth to first shearing, g	0.30‡	2.8‡	3.5	–	–	–	–	–	–
Wool production at 6 months of age, g	–	–	–	0.65‡	0.6‡	27.2	0.91‡	1.6‡	74.8

*r = Gross correlation coefficient; b = adiusted regression coefficient; %v = per cent of variation accounted for by the regression.

†Significant at $p<0.05$.

‡Significant at $p<0.01$.

§No. of observations 308.

¶No. of observations 134.

all positive but very small and non-significant (Table 2). Much higher correlation coefficients between weaning weight and wool production during the first year of the animal's life were reported by Young *et al.* [21], Vesely *et al.* [20], Fahmy *et al.* [4] and Ursescu *et al.* [19], the estimates being 0.24, 0.47, 0.18 and 0.43, respectively. Adjusted regression coefficients of wool production at 6 months of age on weaning weight and pre-weaning average daily gain were positive and significant ($p < 0.01$), and regression of wool production after 6 months on weaning weight and pre-weaning average daily gain were positive but small and non-significant.

Comparisons among the associations between the pre-weaning traits and wool production in different periods (Table 2) and the associations between the pre-weaning traits and body weight at different ages (Table 1) are of considerable interest. Among the pre-weaning traits, as discussed earlier, birth weight had by far the least amount of association with body weight at subsequent ages, whereas the reverse relationship between pre-weaning traits and wool production was observed. Brown and Turner [2] have suggested that there are positive associations between wool production:body surface area:body weight. Therefore, the relationship between birth weight and wool production might be partly due to the birth weight–skin follicle density relationship.

It has also been shown that an unfavorable pre-natal maternal environment, which resulted in low birth weight, could permanently influence the skin follicle population density, the ratio of the number of secondary to primary follicles, and consequently wool production at later ages. Brown *et al.* [3] reported that twin-born ewes (which had relatively unfavorable pre-natal environment as compared with single born ewes) cut less clean wool per year over their lifetime than single-born ewes. They concluded that the relatively lower number of fiber was the main factor for lower wool production in twin-born ewes. Schinckel [13] found that development of all skin follicles was initiated prior to birth, but the number which finally reached maturity and produced fiber was significantly affected by birth weight and growth from birth to one month of age; growth after one month, however, was not important. His report indicated that the larger animals at birth had a greater total number of primary follicles than smaller animals, the difference in total primary follicles resulting primarily from differences in size at 90th day of pre-natal life, rather than from differences in density at that time. These findings explain well the observed differences between different coefficients in this study.

Relationships between wool production and post-weaning traits

Body weight at shearing. The associations between wool production at 6 months of age and body weight at shearing were positive and significant, whereas body weight and wool production were independent at later ages, as shown by negative and non-significant gross correlation coefficients (Table 2). The relationship between wool production from birth to 15 months of age and body weight at 15 months of age was far from the positive and mostly significant correlations (wool production at first shearing and corresponding body weight) found in the literature [4, 7, 10, 11, 15, 18, 19]. A wide range of estimates has been reported by More O'Ferral and Vial [9] for the correlation between wool production and body weight at shearing in different locations.

Daily gain from birth to the first shearing. The association between average daily gain from birth to the first shearing and wool production at first shearing (6 months of age), expressed as gross correlation coefficient and adjusted regression coefficient, were both positive and highly significant (Table 2). The correlation coefficients of wool production

at 6 months of age with daily gain from birth to shearing and with pre-weaning average daily gain were similar.

Wool production at 6 months of age. There was a strong positive relationship between wool obtained at 6 months of age and that obtained at 15 months of age shown by the highly significant correlation and regression coefficients (Table 2). Young *et al.* [21] reported a positive correlation (0.43) between fleece weight at weaning and at 15–16 months. A high positive correlation between clean fleece weight at weaning and yearling was also reported by Pohle [12]. The estimated relationships between wool production at 6 and 15 months of age definitely indicated that lambs could be evaluated at 6 months of age for wool production at 15 months, and even for lifetime wool production based on some reports [16, 19].

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